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LUMPY JAW, OR ACTINOMYCOSIS¹

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CAUSE OF THE DISEASE

The terms “lumpy jaw”, “big jaw”, and “wooden tongue” have been used for decades to describe chronic conditions affecting cattle, calves, and occasionally other livestock. The diseases are characterized by the formation of peculiar, tumorlike swellings containing pus of a granular consistence, usually about the head. At one time, all were considered to have as a common cause the funguslike organism (*Actinomyces bovis*), commonly referred to as the ray fungus. More recently, however, evidence has been accumulating to show that several organisms, some similar to the ray fungus and others of a different nature, may be involved in these diseases.

At present authorities generally agree that the usual cause of the disease in the bone, usually of the jaw, is the ray fungus or other closely related organisms, in which case it is known as actinomycosis, first described by Bollinger in 1877. When the process is in the soft tissues, such as the lymph nodes, or tongue, or membranes of the head and throat, the organism usually found is that known as *Actinobacillus lignièresi*, so called after Lignières who first described it in 1902. In this case the disease is technically classified as actinobacillosis. At other times these tissues may be diseased through the presence of commonly found pus-forming organisms such as *Staphylococcus pyogenes*. Whether the primary lesion is in the bone or the soft tissues of the head, other organs may become diseased through the spread of the infection in the body. Thus, the lungs, liver, spleen, muscles, and even the brain may become involved.

Actinomycosis, as well as actinobacillosis, may in some cases be confused with tuberculosis. The diagnosis does not offer any difficulties, since the presence of the actinomyces fungus and the ab-

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sence of tubercle bacilli at once remove any existing doubts. As has already been intimated, these grains, simulating sulphur balls, are visible to the naked eye, and their nature is readily determined with the aid of a microscope.

EXTENT OF THE DISEASE

Although lumpy jaw is not commonly considered a disease of great economic importance, it is frequently observed in the course of Federal meat inspection and is responsible for considerable loss due chiefly to the condemnation of parts of carcasses and, in some cases, entire carcasses. According to the meat-inspection records, lumpy jaw has increased in prevalence in recent years. During the fiscal year ended June 30, 1930, for example, the disease occurred in approximately 88,500 cattle and calves out of 12,772,352 slaughtered: in 1936 there were about 215,870 cases recorded out of a total of 16,081,427 animals. Most of these cases of the disease resulted in the condemnation of parts of carcasses, usually the head, but there were also 1,350 condemnations of entire carcasses in 1936.

Lumpy jaw may occur in any region where cattle are raised and as a general rule is found only as an occasional case in older cattle. On the other hand, it has been known to be widespread in relatively young slaughter cattle. There is a case on record of an entire shipment of 27 steers each of which was affected to some extent with the disease. Fifteen cases were of sufficient seriousness to cause the condemnation of the entire carcasses and the other 12 passed inspection only after the affected parts and surrounding tissue were removed. Of the 27 heads, 21 were condemned entirely. These steers were conspicuous in the public stockyards owing to the presence of varying enlargements in the region of the head, neck, and shoulders. In many of the animals these tumefactions approached the size of a child's head.

METHODS OF INFECTION

So far as is known, the infection that causes the disease gains entrance to the body tissues through abrasions or lacerations, usually in the mouth cavity. It has been stated that the ray fungus may be present on certain types of forage. Particularly dry, harsh, rough feeds are known to damage the mucous membranes of the mouth by mechanical injury. The sharp, barbed awns of barley and other grains, and of foxtail and other grasses which are sometimes found in feeds, have been found to penetrate the membranes of the mouth, becoming buried in the deeper tissues. The infection may travel into the tissues with these feeds or, if present from other sources, find ready access to the body through the wounds caused by such substances. When cattle are teething, the gums are always more or less tender and lacerated, thus affording another avenue for the ingress of the infection. Finally, the organisms found in these diseases may also invade other parts of the body; for example, the spermatic cord and the udder, usually through wounds.

In lumpy or big jaw the tumors and abscesses on or in the region of the jaw may be in the lymph nodes, the salivary glands, the bones,

the mucous membranes, or other tissues. When these are incised a close scrutiny with the naked eye, or a hand lens, will usually reveal the presence of minute grains, which vary from a pale-yellow to a sulphur-yellow color. They may be very abundant or so few as to be overlooked. They are embedded in the soft tissue composing the tumor or in the pus of the abscess. With a needle they are easily lifted out from the tissue, and then they appear as roundish masses about one-half millimeter (one-fiftieth of an inch) in diameter. To anyone familiar with the use of a microscope the recognition of these grains or particles without any previous preparation is a comparatively easy task. When examined in a fresh condition under the microscope the granules may be found to consist of minute, roundish masses, having a rosettelike structure of club-shaped bodies. Under higher magnification the bodies are rather large in the case of infection with the ray fungus, and minute mycelial threads are to be found within the rayed structure. In actinobacillus infections, and in some cases where only staphylococci are found, the rosettes are smaller in size or absent. In contrast with actinomycosis, in actinobacillosis bacteria instead of mycelia are to be seen within the radiating clubs. Thus the nature of the lesion may be somewhat differentiated, as to cause, under the microscope. Still further certainty may be obtained by cultures made from fresh material. These, of course, are all technical procedures which will only rarely be necessary for the practical treatment of the disease.

Whatever the situation of the disease caused by actinomyces may be, its nature is fundamentally the same and peculiar to the fungus.

The consistence of the tumor varies in different situations according to the quantity of fibrous or connective tissue present. When very little of this is present the tumor is very soft. As the quantity of connective tissue is increased the tumor is firmer and of a more honeycombed appearance. The colonies of the micro-organisms are lodged in the spaces formed by the meshwork of the connective tissue. There they are surrounded by a mantle of cellular elements which fill up the spaces. By scraping the cut surface of such a tumor these cell masses enclosing the organisms come away, and the latter may be seen as pale-yellow or sulphur-yellow specks, as previously described.

LOCATION OF THE DISEASE

In cattle these disease processes may be located both externally, where they are readily detected (fig. 1), and in internal organs. The preferred seat is on the bones of the lower and upper jaws, in the lymph glands of the region, in the parotid salivary gland in the angle of the jaw, and in the region of the throat. They may also appear under the skin in different parts of the body. Internally they may attack the tongue and appear in the form of a tumor in the mouth, pharynx, or larynx and may cause extensive disease of the lungs, more rarely of the digestive tract.

When the disease attacks the soft parts of the head a rather firm swelling appears, in which are formed one or more smaller projecting tumors, varying from the size of a hickory nut to that of an egg. These push their way outward and finally break through the skin as small, reddish, funguslike bodies covered with thin sloughs. Or the original swelling, in place of enlarging in the manner described, may

become transformed into an abscess which finally bursts to discharge creamy pus. The abscess cavity, however, does not disappear, but is soon filled with funguslike growths, which may force their way outward through the opening.

When the tumors are situated within the cavity of the pharynx they have perhaps broken through from some gland, perhaps beneath the mucous membrane, where the disease first appeared, and hang or

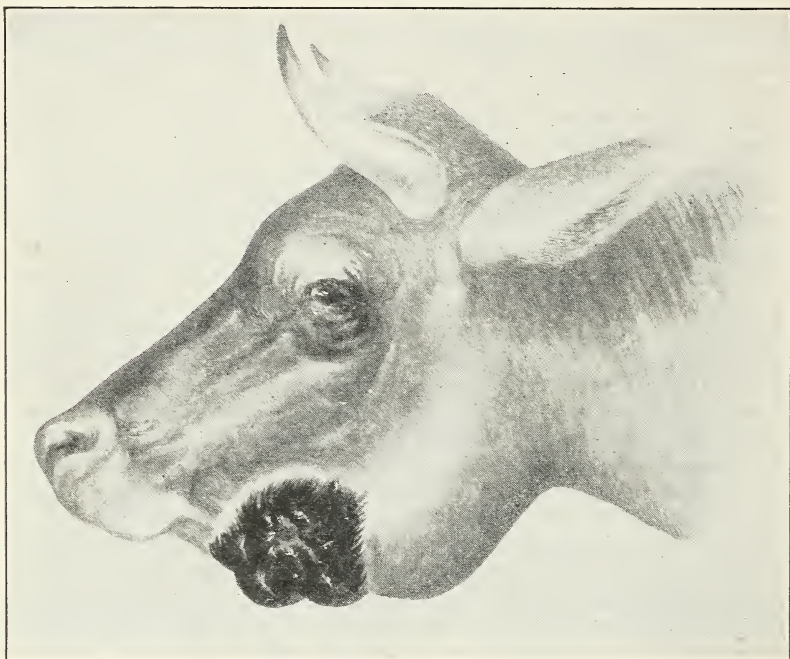


FIGURE 1.—A case of lumpy jaw in a cow. In this instance the lower jaw was the only part affected.

project into the cavity of the pharynx, either as pendulous masses with slender stems or as tumors with broad bases. Their position may be such as to interfere with swallowing and with breathing. In either case serious symptoms will soon appear.

EFFECT ON BONES

The invasion of the bones of the jaws by the ray fungus must be regarded as the most serious form of the disease. So far as is known, the organism probably gains entrance to the bone through the sockets of the teeth, either at the time that these are erupting, or through wounds at the margin of the gums. By a slow extension the infection gradually undermines the entire thickness of the bone itself. The growth may continue outward, and after working its way through muscle and skin finally breaks through and appears externally as stinking fungoid growths. The growth may at the same time work its way inward and appear in the mouth. The disease may also begin in the periosteum, or covering of the bone, and destroy the bone from without inward.

"WOODEN TONGUE"

In the disease which is commonly referred to as wooden tongue, there is an increase in the quantity of fibrous tissue in the organ, which is usually accompanied by areas of pus formation varying in size from that of a pinhead to a pea or larger. The tongue becomes increasingly hard and immobile and may protrude from the mouth in a manner which is very descriptively indicated by the term "wooden tongue." There may or may not be ulcers on the tongue, on the inside of the cheeks, and even on the muzzle. Ulcers or tumorlike formations may occur in the pharynx, the larynx, or even the trachea. Neighboring lymph glands may be involved. The symptoms, of course, vary with the extent and spread of the lesions. When the tongue is enlarged and protruding from the mouth, there is usually a dribbling of saliva from the mouth, an offensive odor, and more or less difficulty in eating. In such a case, the animal usually becomes increasingly thin and weak, finally dying of exhaustion if not treated.

THE DISEASE IN THE LUNGS

Actinomycosis of the lungs is occasionally observed, and it is not improbable that at times it has been mistaken for tuberculosis. The actinomyces grains are, however, easily observed if the diseased tissue is carefully examined. The changes in the lungs as they appear to the naked eye vary considerably from case to case. Thus in one animal the lungs were affected as in ordinary bronchopneumonia as to the location, extent, and appearance of the disease process. The affected lobes had a dark-red-flesh appearance, with yellowish areas sprinkled in here and there. These latter areas were the seat of multiplication of the actinomyces fungus. In another case, of which only a small portion of the lungs was sent to the laboratory, they were completely transformed into a uniformly grayish mass, very soft and pulpy to the touch, and appearing like very soft and moist dough. The actinomyces grains were exceedingly abundant in this tissue and appeared when the tissue was incised as minute, sulphur-yellow grains, densely sprinkled through the tissue, which readily came away and adhered to the knife blade. In still another case a portion of the lung tissue was converted into large, soft masses from 1 to 3 inches in diameter, each partly enclosed in very dense connective tissue. These soft, grayish-yellow masses likewise resembled moist dough in their consistence, and the actinomyces grains, though neither very distinct nor at all abundant, were easily fished out and identified as such. A portion of this growth, which was as large as a child's head, was converted into an abscess filled with creamy, semi-liquid pus.

This case differed from the preceding in that all appearance of lung tissue had disappeared from the diseased mass. Only on the exterior could the lung tissue be recognized, although even there it had been largely converted into very dense, whitish, connective tissue enclosing the fungoid growth. In the other case, the external form of the lung and the shape and outline of the lobules were preserved, but the lung tissue itself was not recognizable as such. In the case first mentioned the changes were still less marked, and actinomycosis would not have been suspected by a simple inspection. These few illustrations suffice to show that actinomycosis of the lungs

may appear under quite different forms, and that the nature of the disease can be accurately determined only by finding the fungus itself.

Actinomycosis rarely attacks the body externally in places other than the head and neck. Crookshank described the case of a bull in which the flank was attacked and subsequently the scrotum became diseased. A large portion of the skin of the flank was destroyed and covered with a leathery crust. When this was pulled away the pus beneath it showed the actinomyces grains to the naked eye.

DEVELOPMENT OF THE DISEASE

The course of the disease is slow. As the tumors grow they may interfere with the natural functions of the body. Depending on their location, mastication, rumination, or breathing may be interfered with, and in this way the animal may become emaciated. Actinomycosis of the jawbones leads to destruction of the teeth and impedes the movements necessary to chewing the feed. Similarly when actinobacillosis attacks the soft parts of the head, obstructions may arise in the mouth by an inward growth of the tumor. If tumors exist in the pharynx they may partially obstruct the movements necessary to breathing or close the air passages and cause partial suffocation. Actinobacillosis of the tongue, in interfering with the many and varied movements of this important organ, is also a serious matter. There is no reason to suppose that the localized disease interferes with the general health in any other way than indirectly until internal organs, such as the lungs, become involved.

A very small proportion of the cases may recover spontaneously, the tumors being encysted or undergoing calcification. Usually, true actinomycosis is a most difficult disease to treat, whereas actinobacillosis, if localized, is believed to be amenable to treatment.

PREVENTION

Investigators still do not know how and where animals contract these diseases. This is true because, so far, there is little information about the life history of the organisms concerned. Most observers believe that animals become infected from the feed, although some believe that the organisms may exist in the normal mouth, awaiting the opportunity to invade the body. The fungus is lodged on plants and in some way enters the tissues of the head, the lungs, and the digestive tract, where it sets up its peculiar activity. It is likewise generally believed that the fungus is, as it were, inoculated into the affected part. This inoculation is performed by the sharp and pointed parts of plants which penetrate the mucous membranes and carry the fungus with them. The disease is, therefore, inoculable rather than contagious. The mere presence of the diseased animal will not give rise to disease in healthy animals unless the actinomyces grains pass directly from the former into some wound or abrasion of the latter, or drop on feed consumed by the latter animals. Not only are these views deducible from clinical observations, but they have been proved by the positive inoculation of calves and smaller animals with actinomyces.

The presence of actinomyces, or ray fungus, in diseased animals, therefore, is of limited danger to healthy animals. Nevertheless an animal affected with this disease or actinobacillosis should not be allowed to run at large or with other animals. If the infection is being scattered by discharging growths we must assume, until more positive information is at hand, that other animals may be infected by such distribution.

However, in the opinion of many authorities, when actinomycosis or actinobacillosis appears among a large number of animals all contract it in the same way from the feed. Much speculation, therefore, has arisen as to whether any particular plant or group of plants is the source of the infection, and whether any special condition of the soil favors it, but very little positive information exists. It would be very desirable for those who live in localities where these diseases are prevalent to make statistical and other observations on the occurrence of the disease with reference to the season of the year, the kind of feed, and nature of the soil (whether swampy or dry, recently reclaimed, or cultivated for a long time) on which the animals are pastured or on which the feed is grown. It is highly probable that such investigations would detect the source of the organisms and suggest some means for checking the spread of the diseases themselves.

Actinomycosis in the Southwest is generally supposed to be the result of eating the prickly fruit of the cactus plant, thus causing wounds of the mucous membrane and subsequent infection by the parasite. Much additional information of a similar kind must be forthcoming before the source and manner of infection in this disease and its dependence on external conditions will be known.

TREATMENT

The treatment of lumpy or big jaw is almost entirely surgical if the bone itself is involved. When the tumors are external and attached to soft parts only, an early removal may lead to recovery. This, of course, should be undertaken only by a trained veterinarian, especially as the various parts of the head and neck contain important vessels, nerves, and ducts which should be injured as little as possible in any operation. Unless the tumor is completely removed it will reappear. Disease of the jawbones is at best a very serious matter, and treatment is likely to be of no avail, particularly if not begun early. As early as 1892, an important contribution to our knowledge of this subject was made by Nocard, of the Alfort Veterinary School, in a communication to the French Central Society of Veterinary Medicine. He showed clearly that the disease of the tongue, known as wooden tongue, which appears to be rather common in Germany, as well as in the United States, could be quickly and permanently cured by the administration of potassium iodide. Nocard called attention to the success of Thomassen, of Utrecht, who recommended this treatment as long ago as 1885, and who treated more than 80 cases, all of which were cured. A French veterinarian, Godbille, used the same remedy in a number of cases of wooden tongue, all of which were cured. Nocard also gives details of a case which he cured. Subsequent accumulated evidence indicates

that disease of the soft tissues, which is usually actinobacillosis, will generally yield to the administration of iodine, in one form or another, but that actinomycosis may not be materially improved by that chemical.

If the potassium iodide is used it may be given in doses of $1\frac{1}{2}$ and $2\frac{1}{2}$ drams once a day, dissolved in water, and administered as a drench. The dose should vary somewhat with the size of the animal and with the effects that are produced. If the dose is sufficiently large, signs of iodism appear in the course of a week or 10 days. The skin becomes scurfy and there are a flow of tears, catarrh of the nose, and loss of appetite. When these symptoms appear the medicine may be suspended for a few days and afterward resumed in the same dose. The cure requires from 3 to 6 weeks of treatment.

Some animals, generally the ones which show no signs of iodism, do not improve under treatment with potassium iodide. It must be realized, however, that in addition to the effect of the drug on diseased tissue, it sometimes produces severe, general disturbance in some animals when administered for long periods. This applies especially to breeding animals which are said by some to be rendered sterile by the continued use of iodine. Also, in many cases in which the tongue or throat is involved, there may be considerable difficulty in swallowing, and if the drug is given by drenching, one must be particularly careful that it does not go into the lungs and cause pneumonia.

If there is no sign of improvement after the animals have been treated 4 or 5 weeks, and the medicine has been given in as large doses as appear desirable, it is an indication that the particular animal is not susceptible to the curative effects of the drug, and the treatment may, therefore, be abandoned.

It is not advisable, however, to administer potassium iodide to milk cows except in cases of necessity, as it will considerably reduce the milk secretion or may stop it altogether. Furthermore, a portion of the drug is excreted through the milk, making it unfit for use. The iodide should not be given to animals in advanced pregnancy, as there is danger of producing abortion.

The best results are obtained by using relatively large doses of the drug until its effect is apparent. The many tests to which this treatment has been subjected have proved, with few exceptions, its specific curative value. In addition to this the tumor may be painted externally with either tincture of iodine or Lugol's solution, or the drug may be injected subcutaneously into the tumor.

Godbille gave as much as 4 drams of potassium iodide in 1 day to a steer, decreasing the dose one-fourth dram each day until it became $1\frac{1}{4}$ drams, which was maintained until the twelfth day of treatment, when the animal appeared to be entirely cured.

Nocard on the first day gave $1\frac{1}{2}$ drams in one dose to a cow; the second and succeeding days, a dose of 1 dram in the morning and evening, in each case before feeding. This treatment was continued for 10 days, when the animal was cured.

The decision as to the best method and extent of treatment for each case should be entrusted to the trained veterinarian. Some extensive and severe cases, particularly in actinomycosis, cannot be treated economically. In such instances, it may be preferable to

fatten and slaughter the animals. Since both actinobacillosis and actinomycosis may affect man, it is advisable that any animal affected with these diseases be inspected as to suitability for food. So far as is known, man does not contract the disease directly either from infected cattle or carcasses, but that he may become diseased through some unknown intermediate agency can scarcely be denied, and under no condition should diseased parts be used as food.

The Federal meat-inspection regulations require condemnation of carcasses of animals showing generalized actinomycosis or actinobacillosis. If carcasses indicate a well-nourished condition of the animal and show uncomplicated, localized lesions of these diseases, they may be passed after the infected organs or parts have been removed and condemned. When the disease of the jaw is slight, strictly localized, and without pus formation, fistulous tracts, or lymph-gland involvement, the tongue, if free from disease, may be passed. The heads affected with lumpy jaw, including the tongue, must be condemned, except that when the lesions in the jaw are strictly localized and slight in extent, the tongue may be passed, if free from disease.

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